Household income and nutrient adequacy in women of reproductive age: a study in Babakan Village, Indonesia

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Abstract. Background: The condition of Chronic Energy Deficiency and anemia often occurs in women of reproductive age and can lead to health problems. Objective: This research aims to examine the relationship between household income and the adequacy of energy, protein, and iron levels in women of reproductive age in Babakan Village. Methods: The research employs a cross-sectional design. The respondents are 78 women of reproductive age, residing in Babakan Village, determined using purposive sampling. The instruments in this research include interview questionnaires (household and characteristics) and 1x24-hour food recall forms (levels of energy, protein, and iron adequacy). Hypothesis testing in this research uses the Spearman test to determine the relationship between household income and the adequacy of energy, protein, and iron levels. Results: The research results indicate a significant relationship between income and iron adequacy with a value of $p < 0.05$, while there is no significant relationship between income, energy, and protein adequacy with a value of $p > 0.05$. Conclusion: This study indicates that higher income may improve access to nutritious foods but does not ensure better nutrient adequacy in this population.

1 Introduction

Women of reproductive age are defined as women aged 15-49 years regardless of their marital status. As potential mothers, this group faces a high risk of various nutritional issues [1]. These issues often involve deficiencies in vital nutrients like energy, protein, and iron. Long-term deficiencies, such as Chronic Energy Deficiency (CED) and iron-deficiency anemia, are prevalent within this group. Insufficient nutrient intake can result in multiple health issues, including lowered immunity and reproductive health problems [2].

CED refers to a condition where the body consistently lacks adequate energy and protein over a long period [3]. Women of reproductive age are especially prone to CED, which can impact their health in the future, particularly during pregnancy [4]. This condition raises the likelihood of women in this age group giving birth to children who may also experience CED [5]. Data from Indonesia's Ministry of Health in 2013 indicated that the prevalence of CED

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among pregnant women of reproductive age was 24.2%, while it was 20.8% for non-pregnant women [6]. By 2018, the prevalence reported a decrease to 17.3% among pregnant women and 14.5% among non-pregnant women [7]. Despite this decrease from 2013 to 2018, the prevalence remains concerning, as it is still over 10%.

On the other hand, anemia is also a common issue among women of reproductive age in Indonesia [7]. Anemia occurs when the body has a shortage of red blood cells or hemoglobin, leading to symptoms like fatigue, weakness, and other health problems [8]. This condition is typically caused by a lack of iron [5]. According to Indonesia's Ministry of Health, the prevalence of anemia among women of reproductive age was 30% in 2013 and increased to 48.9% in 2018 [6,7]. Key contributors to anemia in this group include inadequate nutrient intake, particularly iron, and blood loss during menstruation [9].

Nutritional intake among women of reproductive age is influenced by both internal and external factors, such as lack of knowledge, social influences, and family income [10]. Family income is particularly impactful, as it directly affects their financial capacity and ability to access nutritious foods [11]. Families with higher income levels tend to spend more on food, improving their access to quality nutrition [11]. However, in lower-income families, financial limitations often restrict access to nutrient-rich foods such as vegetables, fruits, and proteins [11]. This limited access can lead to nutritional deficiencies in women from these backgrounds [12]. Additionally, dietary habits within lower-income families may favor cheaper, less nutritious food options, which can further impact nutrition balance [12]. There is limited research that examines the relationship between income and energy, protein, and iron intake, especially in rural areas. This has led the researchers' interest in identifying the relationship between these two variables.

2 Materials and methods

2.1 Design, place, and time

This research employs a quantitative study using a cross-sectional study design. This research was conducted in Babakan Village, Dramaga Subdistrict, Bogor Regency, West Java, Indonesia. The study lasted for three months, from September to November 2023.

2.2 Number and method of taking subjects

The study population comprised women of reproductive age in Babakan Village. Determination of the minimum sample size in this study refers to the Lemeshow formula (1997) which is formulated as follows:

$$n = \frac{Z2\alpha \times p(1-p)}{d2} \quad (1)$$

The minimum sample size calculated was 48 participants. The participants include 78 women of reproductive age who met the inclusion criteria. The inclusion criteria included being a woman aged 15-49 years, residing in Babakan Village, being in good health, and willing to participate in this study by filling out informed consent. In contrast, women of reproductive age who were unwell and pregnant or breastfeeding were excluded from this study.

2.3 Type and method of data collection

This study used primary data, which was conducted through in-person interviews using questionnaires and 1x24-hour food recall forms. To obtain data on subject characteristics, including family income, the researcher used instruments such as questionnaires and interviews. In measuring the adequacy level of energy, protein, and iron, the researcher implemented the 1x24-hour food recall method. The research subjects were asked to recall and record all food and beverages consumed within the last 24 hours. Research ethics were maintained by obtaining informed consent and explaining the purpose of the study to the subjects, as well as ensuring confidentiality of personal data. This study was approved by the Ethics Committee of Community Nutrition, IPB University, with the approval code of 1134/IT3.KEPMSM-IPB/SK/2024.

2.4 Data processing and analysis

This study followed several data processing stages to ensure accurate information from the research subjects. Initially, data was entered into a Microsoft Excel 2010 spreadsheet, where each entry from the interview questionnaire and 1x24-hour food recall was assessed for completeness and accuracy. Subject characteristics, particularly family income, were then coded for easier analysis. Data editing was performed to correct any filling or writing errors, ensuring consistency. Following this, data cleaning involved identifying and rectifying outliers or errors to maintain data integrity. Data analysis was conducted using Microsoft Excel 2010 and SPSS version 27, employing descriptive statistics for subject characteristics and family income levels, a Kolmogorov-Smirnov test for normality, and the Spearman Rank test to evaluate the correlation between income levels and the energy, protein, also iron adequacy levels in woman of reproductive age. Food consumption data, including nutrient intake such as energy, protein, and iron from foods consumed based on the 1x24-hour food recall, were examined using the Indonesian Food Composition Table developed by the Indonesian Ministry of Health in 2019 [13]. Microsoft Excel 2010 was utilized to assist the calculation process, enabling a detailed analysis of macronutrient and micronutrient content in the reported dietary data.

3 Results and discussion

The characteristics of women of reproductive age in Babakan Village are shown in Table 1. This table presents the distribution of age ranges and household income levels, providing a comprehensive picture of the demographic and economic profile of the subjects.

Table 1. Characteristics of women of reproductive age in Babakan Village

Variable	n	%
Age Group		
16-18 years old	9	11.5
19-29 years old	19	24.4
30-49 years old	50	64.1
Mean ± SD	(36 ± 10,7) years old	
Variable	**n**	**%**
Household Income		
< Rp4,520,212 (Below Regional Minimum Wage)	41	52.6
> Rp4,520,212 (Above Regional Minimum Wage)	37	47.4
Mean ± SD	IDR (4,500,000 ± 19.919.880)	
Energy Adequacy Level [14]		
Severe deficit (<70%)	37	47.4

Variable	n	%
Moderate deficit (70-79%)	22	28.2
Mild deficit (80-89%)	7	9.0
Adequate (90-119%)	10	12.8
Excess (≥120%)	2	2.6
Mean ± SD	(70.5 ± 25.0)%	
Protein Adequacy Level [14]		
Severe deficit (<70%)	42	53.8
Moderate deficit (70-79%)	15	19.2
Mild deficit (80-89%)	7	9.0
Adequate (90-119%)	8	10.3
Excess (≥120%)	6	7.7
Mean ± SD	(68.1 ± 33.9)%	
Iron Adequacy Level [14]		
Lack (<77%)	54	69.2
Adequate (≥77%)	24	30.8
Mean ± SD	(62.6 ± 30.8)%	

The majority of women in this study are in the older reproductive age group (30-49 years old). Most women live in households with incomes below the regional minimum wage in Bogor Regency. Families with low incomes tend to face socio-economic challenges that affect their access to high-quality food sources, which leads to poor consumption patterns [12]. The nutrient adequacy levels in this study were evaluated based on the Recommended Dietary Allowances (RDA), outlined by the Indonesian Ministry of Health in 2019 [15]. According to these guidelines, women of reproductive age are recommended to consume energy of 2,100 kcal (16-18 years old); 2,250 kcal (19-29 years old); 2,150 kcal (30-49 years old), protein of 65 g (16-18 years old); 60 g (19-49 years old), and iron of 15 mg (16-18 years old); 18 mg (19-49 years old) per day. Adequacy levels were calculated as the percentage of actual intake compared to these RDA values. This study found that a significant number of women of reproductive age in Babakan Village experience severe energy deficits (47.4%). Insufficient energy intake can trigger deficiencies in essential nutrients, such as protein, vitamins, and minerals, which can adversely affect the nutritional status of women of reproductive age [16]. Meanwhile, it is known that the protein adequacy level also falls under severe deficit (53.8%). Amino acids, which are components of protein, play a crucial role in the immune response by regulating the activation of various immune cells, cellular oxidative states, gene expression, lymphocyte proliferation, as well as the production of antibodies, cytokines, and other cytotoxic substances [17,18,19]. Therefore, protein-calorie malnutrition can impact the T-cell system, leading to increased opportunistic infections and morbidity [17,18,19]. Consequently, severe protein deficits can weaken the immune system of women of reproductive age, increasing the risk of infections and slowing down the healing process [20]. Additionally, during reproductive and pregnancy periods, protein deficiency can negatively affect maternal health and fetal development, as the placenta requires adequate amino acid levels to provide nutrients to the fetus [20]. Furthermore, 69.2% of women of reproductive age also experience iron deficiencies, which can lead to iron deficiency anemia. This condition can cause women to experience fatigue, decreased immune resistance, and cognitive function disturbances that may affect concentration, memory, and mental performance [20,21]. Iron deficiency anemia is also associated with poor reproductive outcomes, such as preterm labor, low birth weight babies, and decreased iron storage for infants, leading to hindered development [22]. In this study, Spearman's rank correlation test was conducted to analyze the relationship between family income and the adequacy of energy, protein, and iron (Table 3).

Table 3. Correlation test between income and nutrient adequacy level of women of reproductive age in Babakan Village

Variable	p-value	R
Energy Adequacy Level	0.056	0.217
Protein Adequacy Level	0.083	0.198
Iron Adequacy Level	0.045	0.228

The study found no significant correlation between family income and energy intake ($p = 0.056$). Although this study did not observe a significant correlation between income and energy adequacy, the findings from prior research present various perspectives. For instance, a study conducted in rural areas in Yogyakarta, Indonesia, found a significant positive correlation between income and energy intake in rural households, suggesting that higher income facilitates better access to staple foods that fulfil caloric requirements [11]. In contrast, research in rural areas in South Sulawesi, Indonesia, indicated that higher-income groups tend to prioritize nutrient density over total caloric intake, emphasizing food quality rather than quantity [23]. This divergence in findings may help explain no correlation observed in the study, as families in Babakan Village may prioritize energy-dense, cost-effective foods, influenced by local cultural and dietary practices.

Consistent with energy intake, this study found no significant correlation between family income and protein intake ($p = 0.083$). The literature on this topic presents mixed findings depending on the context. For instance, a study conducted in Indonesia reported that dietary diversity, including the consumption of protein-rich foods, tends to increase with higher income [24]. However, in regions where plant-based diets are more prevalent, protein adequacy may be influenced more by factors such as food accessibility and nutritional awareness than by income levels [25]. This aligns with the findings in Indonesia, where the primary protein sources tend to be derived from legumes or low-cost animal products such as tofu, tempeh, and egg, which show variation across income groups [26].

However, family income significantly correlates with iron intake in women of reproductive age ($p = 0.045$). This interpretation indicates higher-income families tend to have better access to high-quality and varied foods, potentially leading to adequate iron consumption [27]. Research in Indonesia has also indicated that higher-income households are more likely to purchase iron-rich foods, such as meat, fish, and fortified products, highlighting income as a key factor in access to micronutrient-dense foods [11, 28]. However, the results of this study also suggest that the relationship between income and iron adequacy cannot be entirely attributed to dietary intake. The use of government-provided iron supplements, particularly those distributed through anemia prevention programs in Indonesia, may disproportionately benefit higher-income groups who have better nutritional knowledge and access to healthcare facilities.

The lack of significant correlation between income and energy or protein intake may be attributed to broader social and behavioral factors, including eating habits, food distribution systems, and cultural food preferences, which were not controlled for in this study. Additionally, the use of a 1x24-hour food recall method to evaluate nutrient intake only provides a limited representation of the respondent's diet on a single day, which may not accurately reflect their usual dietary patterns [29]. These limitations could lead to inaccurate estimates of energy, protein, and iron adequacy. Furthermore, recall bias may also be present, as respondents may inadvertently forget or misreport the types and amounts of food consumed [30]. Therefore, future research should consider employing multi-day food recall or food frequency questionnaires to ensure a more comprehensive and reliable assessment of dietary intake. Controlling for potential confounding variables would also enhance the understanding of the relationship between income and nutritional adequacy.

4 Conclusion

The majority of subjects in this study had low income and severe deficits of energy, protein and iron adequacy. While no relationship was found between income level and energy or protein adequacy, a correlation with iron adequacy was identified. These findings provide insights into the nutritional challenges experienced by women of reproductive age in Babakan Village, addressing a critical gap in localized data on energy, protein, and iron deficiencies within low-income populations. However, several limitations should be acknowledged. The cross-sectional design of the study limits the ability to establish causal relationships between income levels and nutrient adequacy. Furthermore, the sampling frame was confined to Babakan Village, which may restrict the generalizability of the findings to other settings or urban populations. Additionally, dietary intake was self-reported using a 1x24-hour recall, potentially introducing recall bias and limiting the ability to capture habitual dietary patterns accurately. Future studies could address these limitations by using multi day dietary recalls to provide a more accurate picture of eating habits and expanding the sampling area to make the findings more comprehensive and widely applicable.

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